coolness of the air, the vapor more readily condenses upon the dust particles. The dust particles thus become larger and consequently not so effective in turning back the blue rays alone, but others are also reflected and a grayish effect is produced. In a single location the blue of the sky may appear bluer at one time than another. The sky is oftentimes said to be very blue when some white cumulus clouds are outlined against it. The sky is then a deep blue by contrast with the brilliant white. After a shower, when the lower stratum of air is washed of its coarse dust particles, a deeper and purer blue is the result.

As one looks toward the sun, especially at sunset, the reds are prominent. The dust particles are then between the sun and the observer, and so the blues are reflected away from the observer while the reds pass on to the observer's eye. One might suppose that the sun ought to appear red rather than white when one looks directly at it, because the stratum of air containing the dust is between the observer and the sun and thus there would be a diminution of the shorter wave rays to the eye. This is explained by assuming that the sun is really blue if observed from a point beyond our atmosphere; the subtraction of the blue rays as they are scattered by the particles in our atmosphere is just sufficient to produce the white sun as it appears to us.

The same mail brings us the latest contribution of Lord Rayleigh to this subject, viz, an article published by him in the April number of the L. E. D. Phil. Mag. (5) XLVII, pp. 375–384. In this article Lord Rayleigh shows that we may not need to have recourse to the suspended particles of foreign matter, solid or liquid, but that in the absence of these we should still have blue sky if the molecules of the atmospheric gases are large enough or massive enough to produce either diffraction or selective reflection. The same train of argument can be applied to the case of a beam of light passing through a shower of falling raindrops or through a mist or a cloud. As an illustration the following example is computed. Let a be the radius of a raindrop or cloud particle, expressed in centimeters as the unit of length; n the number of drops per cubic centimeter; x the length of path of the ray of light through the cloud. Then the length of path required in order to reduce the intensity of the light from 1 down to 0.37, or in the ratio 2.7 to 1 is given by:

$$x = \frac{1}{n \pi a^2}$$

Suppose that $a = \frac{1}{20}$ of a centimeter and $n = \frac{1}{1000}$ that is to say, suppose there is one drop of 1 millimeter in diameter for every liter of space, then the transmitted light will be reduced to one-third (0.37) of the original intensity when it has passed through 1 kilometer of the resulting hazy air. According to this theory a distant point of light seen through a shower of rain ultimately becomes invisible, not by failure of definition, but by loss of intensity (either the absolute intensity or that relative to the intensity of the scattered light in the neighborhood of the object) due to the diffractive action of the raindrops or fog particles.

Lord Rayleigh adds:

> If the view suggested in the present paper that a large part of the light from the sky is diffracted from the molecules themselves be correct, then the observed incomplete polarization at 90° from the sun may be partly due to the molecules behaving rather as elongated bodies with indifferent orientation than as spheres of homogeneous material.

ABSTRACTS OF UNIVERSITY THESES.

In order to attain the degree of Master of Arts or Master of Science, and especially that of Ph. D., all universities require the candidates to submit theses upon special subjects which they have investigated in their courses of study. These theses often contain facts and principles of general importance to science. In European universities it is quite common for such theses to be published, and as we have remarked in the MONTHLY WEATHER REVIEW for September, 1898, page 413, the thousands of theses that have been published within the past century constitute an important portion of the grand structure called science. In so far as the theses at American universities bear upon the work of the Weather Bureau, the Editor will be glad to receive from the authors either full abstracts or the originals for publication in the MONTHLY WEATHER REVIEW. The number of theses submitted by successful candidates for the degree of Ph. D., in the summer of 1898, in some branch of science was as follows:

Chicago	12	Wisconsin	2
Yale	11	Bryn Mawr	1
Johns Hopkins	19	Leland Stanford, Jr.	2
Harvard	11	Nebraska	2
Pennsylvania	8	Brown	1
Columbia	10	California	1
Cornell	11	Columbian	1
Clark	12	Minnesota	0
Michigan	0		
New York	1	Total	105

In addition to the universities we must also consider the schools of technology, thus, in the catalogue of the Massachusetts Institute of Technology for the year 1898–99, we find enumerated 204 theses of successful candidates, five of whom took the degree of Master of Science, while the remainder took the degree of Bachelor of Science. The thorough courses of instruction in dynamics, thermodynamics, hydraulics, and pneumatics given at this institution justify the hope that among these many candidates there must be at least a few whose attention has been turned toward the problems of meteorology.

STORM CENTERS IN THE PACIFIC.

The Pilot Chart of the North Pacific Ocean for the month of May, 1899, contains a synoptic weather chart of the eastern portion of the North Pacific Ocean for Greenwich noon of March 7, 1898. This is one of the few cases in which a fairly satisfactory synoptic chart has been published showing the isobars and winds around a storm center in the North Pacific. The abundance of reports received by the U. S. Hydrographic Office, will, we hope, encourage that important office to compile and publish such charts daily, for there could be no more important contribution to our knowledge of the meteorology of the ocean. In the present case an important storm center is shown to be central at N. 33°, W. 132°, midway between San Francisco and Honolulu, directly in the path of many sailing vessels and steamers. The daily map of the Weather Bureau shows that at this time the low area extended eastward across the Rocky Mountain Plateau region, and that storm centers were also present there. This is, therefore, a case of a very long oval, almost a trough, stretching in a northeast or east-northeast and southwest direction, between the tropical high area on the Pacific and one that at that time prevailed in the eastern portion of the American Continent.

The mere fact that such extensive troughs, containing several special centers of low pressure, can exist for several days, moving as a whole eastward, while the individual lows may move either southeast or northeast, suffices to show that the thin layer of air near the surface, within which the clouds and rain and high winds occur, is but a small portion of the whole atmospheric disturbance. The latter generally begins with a trough of low pressure and but slight cloudiness; as the clouds rapidly increase and the sun's heat is absorbed by them, the lower winds increase, the pressure falls, rain sets in, and special low areas develop within the trough.

The special low centers and cyclonic winds may be formed, according to Espy's and Ferrel's views, as a consequence of the formation of clouds and rain, and the disturbance of thermal equilibrium, but the original trough of low pressure appears to be a mechanical result of the general circulation of the atmosphere which forms the several tropical areas of high pressure and the troughs that separate them, including the equatorial trough as the general separation between the Northern and Southern Hemisphere, and including the polar areas of low pressure. Buchan's chart of isobars for March shows three centers of high pressure in the Southern and four in the Northern Hemisphere; two ovals with three centers of low pressure in the Northern Hemisphere, one in the south polar region, and one equatorial trough, having two or three centers within it.

The relation between special troughs and storm centers over the Atlantic Ocean is explained on page 6 of the MONTHLY WEATHER REVIEW for January, 1894. Troughs occur very frequently over the eastern portion of the North American Continent.

CORRIGENDA.

Mr. Curtis J. Lyons desires to make the following corrections applicable to the Honolulu records for some time past:

The wind force is given on the Beaufort scale: 0–12. At the head of the column the word maximum should be omitted.

The mean dew-point and relative humidity for the month is as given by the formula:

$$(6 \text{ a. m.} + 9 \text{ a. m.} + 2 \text{ p. m.} + 9 \text{ p. m.}) \div 4.$$

The ground is 43 feet and the barometer cistern 50 feet above sea level.

The mean pressure for the month, as deduced from twenty-four hourly observations, is 0.01 higher than the mean pressure at 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time.

The mean of maximum temperatures for February, 1899, is 78.5°, and not 77.0°.

February REVIEW, page 41, second column, third line from bottom, for "12th" read "11th." Last line, for "night" read "morning."

Page 42, second column, first line, for "night" read "morning." Second line, for "Sunday" read "Saturday."

Page 42, first column, table, for Galveston, instead of "6" read "8° F. at 10 a. m. of the 13th; departure below the previous lowest, 3° instead of 5°.

THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

March, 1899, was for the most part a wintry month—cold and disagreeable in the northern sections, with a surfeit of rain in the southern Appalachian region, and frequently alternating periods of fair and stormy weather from the Atlantic to the Pacific.

Notable characteristics of the month were: (1) The termination of the drought in California; (2) the large number of lows that moved from the Pacific to the Atlantic; and (3) the shifting of the Plateau high to Manitoba.

The rains in California up to the 15th of the month had been scanty and disappointing. In southern California the water famine had begun to assume serious proportions, the supply for domestic purposes in some places being inadequate to the demands. The rains from March 15 to the end of the month were especially timely. Persons familiar with the conditions that have existed during the last eighteen months assert that if rain had been delayed ten days longer there would have been total failure of all crops, as was the case in some localities last year.

The number of lows that passed across the country from the Pacific to the Atlantic was much greater than usual for the season, and the paths traveled were considerably south of the normal course. Six storms in all can be traced from ocean to ocean, each of which was accompanied by heavy and quite general precipitation in some part of its course. An unusual condition, viz, the fall of rain or snow simultaneously from the Atlantic to the Pacific, was observed on the morning of the 14th, the storm center being in western Kansas and eastern Colorado. It is quite likely, however, that the precipitation in some parts of the storm area was due to the influence of secondary depressions that had either filled up or united with the main storm on the morning of the above-named date.

Severe local storms and tornadoes occurred on the 3d and 4th in South Carolina, Georgia, Tennessee, and northern Alabama; on the 15th in northern Alabama and Georgia; on the 18th in Alabama, Georgia, Mississippi, and Arkansas; on the 22–23d in Georgia; on the 27–28th in the Carolinas, Georgia, and Alabama.

On the 3d and again on the 27th local storms began in the Carolinas before they were observed in Georgia and Alabama. The position of the general storm center with reference to the region of severe local storms, however, remained nearly constant.

The general character of the month will be seen from a study of the following tables:

TEMPERATURE OF THE AIR.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	10	33.0	0.0	− 2.2	− 0.7
Middle Atlantic	12	40.3	+ 0.9	− 5.7	− 1.9
South Atlantic	10	56.0	+ 2.8	− 3.0	− 1.0
Florida Peninsula	7	67.1	+ 1.4	− 0.2	− 0.1
East Gulf	7	59.8	+ 1.5	− 8.6	− 2.9
West Gulf	7	59.4	+ 1.6	− 8.2	− 2.7
Ohio Valley and Tennessee	12	43.8	− 0.2	−10.4	− 3.5
Lower Lake	8	31.6	− 0.7	− 5.8	− 1.9
Upper Lake	9	21.5	− 5.0	−11.8	− 3.9
North Dakota	7	8.8	−11.7	−13.8	− 4.6
Upper Mississippi	11	29.5	− 6.4	−13.2	− 4.4
Missouri Valley	10	27.6	− 8.3	−13.1	− 4.4
Northern Slope	7	21.3	−10.6	−18.6	− 6.2
Middle Slope	6	38.0	− 4.3	−13.4	− 4.5
Southern Slope	6	49.6	− 0.8	−11.5	− 3.8
Southern Plateau	9	51.5	− 0.3	− 1.5	− 0.5
Middle Plateau	13	38.9	− 0.9	+ 2.3	+ 0.8
Northern Plateau	10	36.0	− 2.2	− 1.8	− 0.6
North Pacific	9	42.7	− 2.6	− 2.3	− 0.8
Middle Pacific	5	51.2	− 1.1	+ 1.7	+ 0.6
South Pacific	4	55.4	− 1.2	+ 1.9	+ 0.6

PRECIPITATION.

The numerical values of total precipitation and total depth of snowfall are given in Tables I and II, and the geographic distribution is graphically shown on Charts III and VIII. The depth of snow on the ground is also shown on Chart IX.